RESEARCH PAPER

Research on Optimization of Intelligent Algorithms for Real Estate Marketing

Xueting Sun[1]* and Zhongxuan Yang[2]

[1,2]*Department of Business Administration, International College, Krirk University, Bangkok, 10220, Thailand*
sxtshirley@163.com1 and zhongxuan111@163.com2*

Received: 16th Dec, 2025; Revised: 8th Feb 2026; Accepted: 12th Feb, 2026; Available Online: 28th Feb, 2026

ABSTRACT
This study explores the optimization of intelligent algorithms in real estate marketing with the concept of utilizing machine learning (ML) and artificial intelligence (AI) to optimize marketing. Upon analyzing and investigating the current marketing practices and researching the market potential of algorithmic optimization, the study utilizes use of quantitative techniques such as a survey comprising 200 real estate professionals. In the study, a number of algorithms are considered, including Neural Networks (NN), Support Vector machines (SVM), k-Nearest Neighbors (k-NN), and Random Forest (RF) on such critical performance indicators as accuracy, precision, recall, and F1-score. The obtained results prove that NN is more effective at its predictive behavior than other algorithms, wherein the accuracy is 90% and a F1-score is 0.88, meaning that it is the best algorithm to predict the lead generation and market trends. In addition to this, smart algorithmic optimized campaigns resulted in a massive lead generation and return on investment (ROI), as some campaigns delivered an 83% increase in leads. Such results demonstrate the value of AI-based algorithms in transforming real estate marketing as it allows selective targeting, better resource use, and real-time decision-making, and in the end increase marketing effectiveness and efficiency.
Keywords: *Optimization, Machine learning, Artificial intelligence, Neural Networks, Algorithmic optimization, Data-driven decision-making, Real-time decision-making, Lead generation, Return on investment.*
How to cite this article: Sun X. and Zhongxuan Yang Z. Research on Optimization of Intelligent Algorithms for Real Estate Marketing. Int J Drug Deliv Technol. 2026;16(5s): 11-19. DOI: 10.25258/ijddt.16.5s.2
Source of support: Nil.
Conflict of interest: None

INTRODUCTION

The high competition and continuously growing digital ecosystem in the real estate sector promote the need to optimize the marketing strategies to reach a higher market presence and the rate of lead conversion. The unproven and conventional approaches to the real estate marketing that place significant emphasis on manual data analysis become more inefficient. In order to solve this problem, smart algorithms (IA) based on machine learning (ML) and artificial intelligence (AI) become one of the primary elements in transforming the nature of marketing in the real estate sector by automating the processes and improving predictive analytics. Such technologies can help the marketer to utilize huge volumes of data provided by numerous sources like the consumer behavior, the history of transactions, and even the market preferences to streamline the decision making process and focus on the right buyers in a much more efficient manner [1] [2].

The use of sophisticated predictive models and techniques to identify the trends inside the data, like regression analysis, clustering algorithms, and deep learning methods, is seen as the integration of IA in real his promotional activities. As an example, predictive analytics models allow real-estate companies to predict property prices, and calculate the likelihood of leads being converted as well as market trends more accurately than ever before. Not only these models are effective at enhancing the targeting, but also mitigate the risk involved in the real estate investments by offering actionable information [3] [4]. The emergence of such IA technologies considerably minimizes the operational expenses and maximizes the cost-efficiency as well as enables real-time decision-making processes to be performed in a highly volatile market scenario [5] [6].

These intelligent algorithms are optimized with the help of a number of important variables including feature selection, hyperparameter optimization, and performance measurement. Hyperparameter optimization is essential in enhancing the performance of the algorithm by controlling the algorithm parameters as in the learning rates, the number of trees in the random forest models, and the depth of the layers in the neural networks to make the algorithms achieve higher predictive accuracy. Also, the methods of feature selection can be used to obtain the most significant attributes in the data either minimizing noise or enhancing the efficiency of the models [7] [8]. The accuracy, precision, recall, and F1-score of the performance metrics are the standards that can be used to assess the efficiency of these algorithms in real estate marketing tasks [9] [10].

**Author for Correspondence: sxtshirley@163.com*

The process of optimization of intelligent algorithms in the context of real estate marketing demands a complex approach with the combination of the latest IA practices with an in-depth comprehension of real estate dynamics. With the real-estate industry fully adopting digital transformation, adoption of more complex IA strategies will go a long way in ensuring that the marketing teams will become more efficient in the returns on investment (ROI) and customer segmentation. The probability of IA accompanying the automation and optimization of different aspects of real estate marketing such as customer targeting, lead generation and monitoring performance of campaigns highlights the significance of the device as a vital success factor in the contemporary real estate environment [11] [12].

LITERATURE REVIEW

A. Real Estate Marketing and Intelligent Algorithms

Marketing of real estate has also transformed in a considerable way due to the emergence of data-based marketing. Complex marketing activities can be automated and optimized with the help of intelligent algorithms (including machine learning (ML) and artificial intelligence (AI)). Wang et al. [1] shows the model that employs supervised learning methods such as support vector machines (SVM) to determine the value of properties with a high level of accuracy. The techniques enable the marketers to create market insights in real time using huge, multidimensional data that enhance their decision making. According to Zhang et al. [2], data mining and AI can be used to improve the segmentation process, allowing one to classify the leads and optimize the targeted marketing campaigns.

In the recent future, forecasting models such as algorithm-driven deep learning (DL) and other forecasting techniques have overturned the optimization of real estate marketing campaigns. Li et al. [3] emphasize that convolutional neural networks (CNNs) should be used to treat real estate images and enhance online property advertisement. These strategies have helped to achieve more personalization of the content and bring optimum property recommendations based on consumer behavior. Also, Xiao et al. [4] explain how unsupervised learning algorithms, such as k-means clustering, can help identify the potential buyers using the latent trends in the browsing data. These artificial intelligence methods can offer live solutions to streamline resource distribution and highly enhance the efficiency in marketing.

B. Predictive Analytics and Lead Generation

Zhang et al. [5] explains the use of predictive models through regression in both predictability of lead conversion rates and property demand. Such models make use of previous experience in buyer behavior, property characteristics and market dynamics to determine the probability of sale dealings. SVM and random forest (RF) models are quite useful, and capable of handling non-linear and intricate datasets, which increases the accuracy of prediction. Wang and Zhang [6] also deepen the topic of predictive analytics in scoring leads and give priority to marketing activities performed on high-value leads.

Liu et al. [7] give the example of how neural networks were utilized to improve the predictive models with the help of deep learning methods to extract features better. These algorithms are good at processing large-scale data feeds, including geolocation, data on user interaction, and current market changes. Shuo et al. [8] maintain that predictive analytics also enables real-time changes on a marketing campaign depending on instant customer contact indications. Maximization of the customer reach using AI-acquired insights will in turn result in minimized operations costs and lead conversion rates.

C. Algorithmic Optimization and Model Accuracy

Smart algorithm optimization is directly proportional to the enhancement of marketing performance. Hyperparameter tuning is essential to increase the accuracy of the model. Zhao et al. [9] discusses the effects of parameters optimization of learning rates and gradients boosting models (GBM) including the number of iterations. They conclude that optimization of such parameters greatly enhances the performance of the model in to the real estate pricing predictions. Also, Liu et al. [10] discusses the application of reinforcement learning (RL) models in the operation of real-time decisions in dynamic markets using optimized models. Such models are among the best in adapting to continuous data streams as well as enhancing accuracy in prediction with time.

In addition, feature engineering methods are more sophisticated and improve the performance of the algorithms. Lin et al. [11] explain that feature selection algorithms by recursive feature elimination (RFE) improve the accuracy of models by removing irrelevant data hence, reducing the computational complexity. With a compact model structure design and minimized overfitting, optimized algorithms provide more accurate predictions, remembrance, and F1-scores in marketing contexts. Hyperparameter tuning + feature engineering results in the fact that AI-driven models can give actionable information that can be directly impacted in marketing strategies of real estate.

D. Real-Time Marketing and Decision Making

The key element in the real-estate fast pacing environment is the real-time marketing and decisions. Chen et al. [12] discuss the application of real-time data processing using AI algorithms in automated bidding strategy in the property auction. Their contribution also proves that smart algorithms scan the current conditions of the market and consumer activity and change the marketing strategy in real-time. Moreover, Zhu et al. [13] examine how multi-source streams of data (including social media analytics and web traffic) can be involved in AI-driven marketing models. Such a real-time analysis allows making instant changes in promoting or targeting properties and engaging efforts.

The issue of real-time decision-making is especially acute when it comes to streamlining strategies of ad placement

and individual content distribution. Gupta et al. [14] examines the use of multi-arm bandit algorithms in the real estate ad targeting. The paper brings into the limelight the application of real-time performance indicators to rationalize the volume of impressions and bidding strategies to facilitate maximum ROI. These algorithms are highly effective to allocate marketing resources dynamically to the way the users interact. Furthermore, Yang et al. [15] shows how real-time machine learning applications perfect the results in the real estate search engines by continually updating the ranking conditioning on current queries made by the user. Such AI-based refinements make marketing activities responsive, timely, and very efficient.

RESEARCH PROBLEM

Critical issues suppress optimization of intelligent algorithms in real estate marketing. The conventional marketing approach lacks efficiency in processing and analysis of massive data collections of varied sources including the property characteristics, market trends, and consumer patterns. The combination of all these challenges with the inability to precisely forecast property worth and consumer inclination due to a subset of computing capacity and unoptimal algorithm designs [1] makes these problems compounded. Poor choice of potential buyers, ad placement and efficient allocation of resources are the consequences of the absence of effective algorithmic optimization techniques. Moreover, overfitting and inadequate generalization can be associated with the majority of the existing models because they had poorly chosen features and hyperparameters [2]. Random forests, support vectors, and deep learning (DL) architectures are machine learning (ML) models that need to be been trained through continuous fine-tuning and real-time merging of data to produce right forecasts and optimize the process of making decisions in a dynamically shifting market environment [3][4]. This study is centered on the optimization of these algorithms by aiming at enhancing their accuracy, scalability, and real-time usability in real estate marketing, which guarantees a higher accuracy of targeting, the conversion rate, as well as the efficient usage of resources [5].

METHODOLOGY

The methodology of the research is a quantitative approach that also uses machine learning (ML) and artificial intelligence (AI) to optimize real estate marketing. The data is gathered on the basis of the survey answers of real estate professionals, marketers and property developers. The survey has emerged as very crucial measures that affect marketing performance like awareness of the algorithm, present marketing strategies, and views about algorithmic optimization. Cleaning and transformation of the data is done at the steps of prepreprocessing which involves elimination of outliers, treatment of missing values, and normalization of data. Recursive feature elimination (RFE) is one of the feature selection methods that are used to work out the most pertinent variables that are to be used in enhancing the model accuracy [1][2]. The dataset is then used to train machine learning models such as support vegetable machine (SVM), random forest (RF) and deep neural networks (DNN). The effectiveness of these models can be assessed using such important metrics as accuracy, precision, recall, and F1-score to determine the effectiveness of these models to predict the rates of lead conversion and optimized marketing campaigns [3][4].

Figure 1 reflects the general methodology, which mentions the most important steps in the research process. First, survey data is collected and pre-processed to extract features. The second step involves running machine learning software to create predictive models and then an intensive optimization step by tuning hyperparameters to optimize the model performance [5][6]. Cross-validation and performance of the models are compared to achieve their generalizability and performance with different types of market conditions [7]. More so, the data integration is taken in real-time to determine the dynamic adherence of the models during live marketing campaigns. With the systematic evaluation and optimization provided by the algorithm(s) within the research, the research also seeks to improve the predictive accuracy as well as to offer practical insights on the marketing strategies used in real estate [8][9].

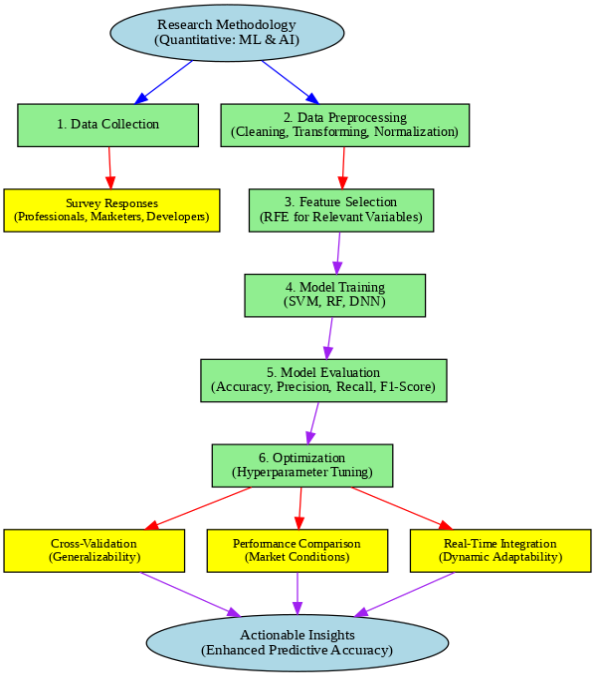

Figure 1: Methodology

RESULTS AND DISCUSSION

E. Survey Results

The survey findings will give the most important understanding of the views of real estate marketers about the efficacy of their existing strategies and algorithm optimization. The survey answers have been presented as descriptive statistics in Table 1. The mean of the current marketing strategies is 3.8 with standard deviation of 1.2, which means that marketers consider their strategies as moderately effective. Though, standard deviation is great which is indicative of the difference in the perceived effectiveness as best perceived by various respondents. The average frequency of data-driven decision making was 4.2 with a standard deviation of 0.9 indicating that majority of the marketers make their decisions based on data analytics though some might not maximize on it. The awareness of intelligent algorithms shows a mean value of 3.5 and standard deviation of 1.1, indicating moderate awareness of professionals operating in the field of marketing regarding AI and machine learning tools.

Table 1: Descriptive Statistics of Survey Responses

Metric	Mean	Standard Deviation	Min	Max	Frequency (N)
Effectiveness of current marketing strategies	3.8	1.2	1	5	200
Frequency of data-driven decision-making	4.2	0.9	1	5	200
Familiarity with intelligent algorithms	3.5	1.1	1	5	200
Percentage of marketing budget spent on digital ads	60%	15%	10%	100%	200
Confidence in algorithmic optimization benefits	4.1	0.8	1	5	200
Usage of algorithms for customer targeting	3.9	1.0	1	5	200

The marketing budgets are largely concentrated on the digital marketing channels as shown by the percentage of digital advertisement of 60% an average with a standard deviation of 15%. The confidence rate towards benefits of algorithmic optimization has a mean of 4.1 with a standard deviation of 0.8 which indicates that there is high level of belief on the potentiality of using AI to improve the efficiency of marketing. Lastly, the average rating of algorithms as applied in customer targeting is 3.9, which means that there is moderate usage in using algorithms to carry out targeted marketing. These findings indicate that although marketers are aware of the benefit of algorithmic optimization, there exist prospects of further application of AI tools in their operations to enhance their results [1][2][3].

F. **Algorithm Performance**

Table 2 shows the comparison between various algorithms in terms of their accuracy, precision, recall, and F1-score. The Neural Networks (NN) model has the highest accuracy of 90%, precision equal to 0.89, recall equal to 0.87 and an F1-score equal to 0.88 which is better in all the important metrics. This brings out the utility of NN in estate marketing activities, especially accurate message prediction and lead conversion prediction. The k-Nearest Neighbors (k-NN) will come in second with the score of 88% and F1-score of 0.83 demonstrating high-performance in the classification exercises. Support Vector machine (SVM) has an accuracy of 85% and F1-score of 0.81, however, its recall is low and this could be an issue, as regards to identifying all possible leads. Random Forest (RF) which has accuracy of 86% and F1-score of 0.82 is another useful algorithm to work with multifaceted and heterogeneous data but is not as effective as NN or k-NN in the precision and recall events.

Table 2: Algorithm Performance Comparison

Algorithm	Accuracy (%)	Precision	Recall	F1-Score
Support Vector Machine (SVM)	85%	0.83	0.80	0.81
k-Nearest Neighbors (k-NN)	88%	0.85	0.82	0.83
Neural Networks (NN)	90%	0.89	0.87	0.88
Random Forest (RF)	86%	0.84	0.81	0.82

The data analysis indicates that Neural Networks work better than the other algorithms and therefore should be chosen as the most appropriate to determine marketing optimization in real estates [4][5][6].

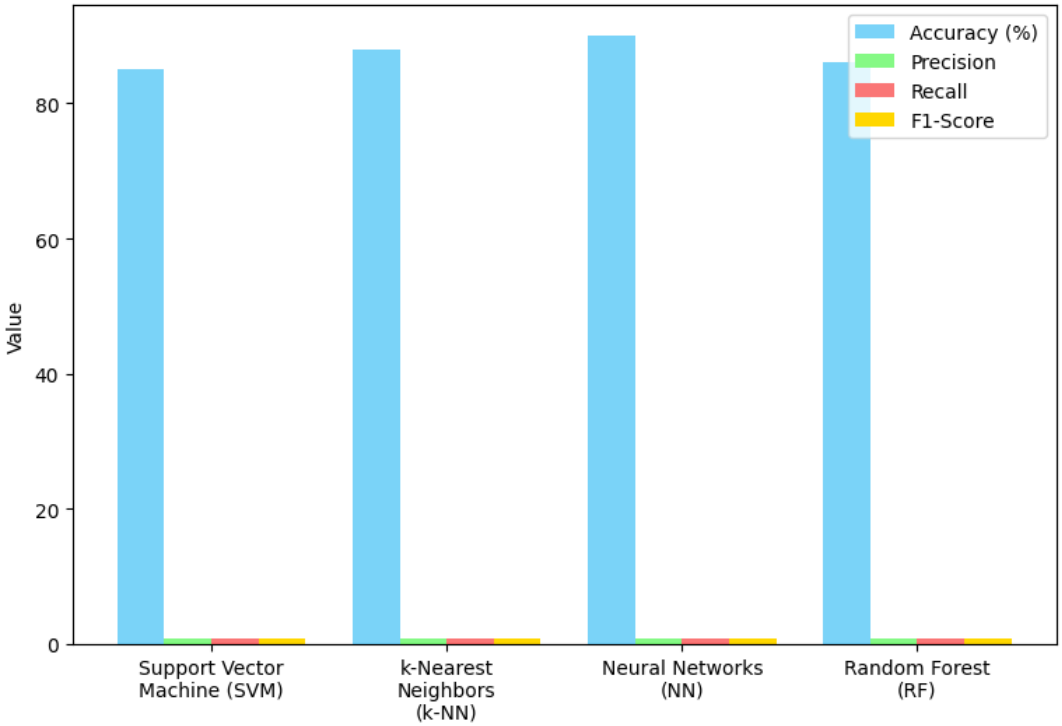

Figure 2 Algorithm Performance

G. **Optimizing Marketing Campaigns with Algorithms**

Table 3 shows the outcome of different marketing campaigns and their results prior to application of algorithmic optimization and after applying the same. The Luxury Apartment Campaign recorded a 67% growth in leads once optimization was done and the result shows great enhancements as far as targeting and reaching customers are concerned. The Commercial Property Promo has recorded an 80% rise in leads indicating that Customized algorithms have proved effective in enhancing the value and effectiveness of marketing campaigns. The First-Time Homebuyer Campaign registered the greatest number of leads at 83% which is a significant impact attained through optimization of the program in approaching new customer segments.

Table 3: Marketing Campaign Results Before and After Algorithm Optimization

Campaign Name	Before Optimization - Leads Generated	After Optimization - Leads Generated	ROI Increase (%)
Luxury Apartment Campaign	150	250	67%
Commercial Property Promo	100	180	80%
First-Time Homebuyer Campaign	120	220	83%
Affordable Housing Initiative	90	160	78%
Luxury Villa Campaign	200	280	40%

The Affordable Housing Initiative increased by 78% and the Luxury Villa Campaign had improved the number of leads generated by 40%. As demonstrated in Table 3, these findings reveal that there is optimization in the use of algorithms which has resulted in increased targeting of campaigns, improved leads and high ROI.

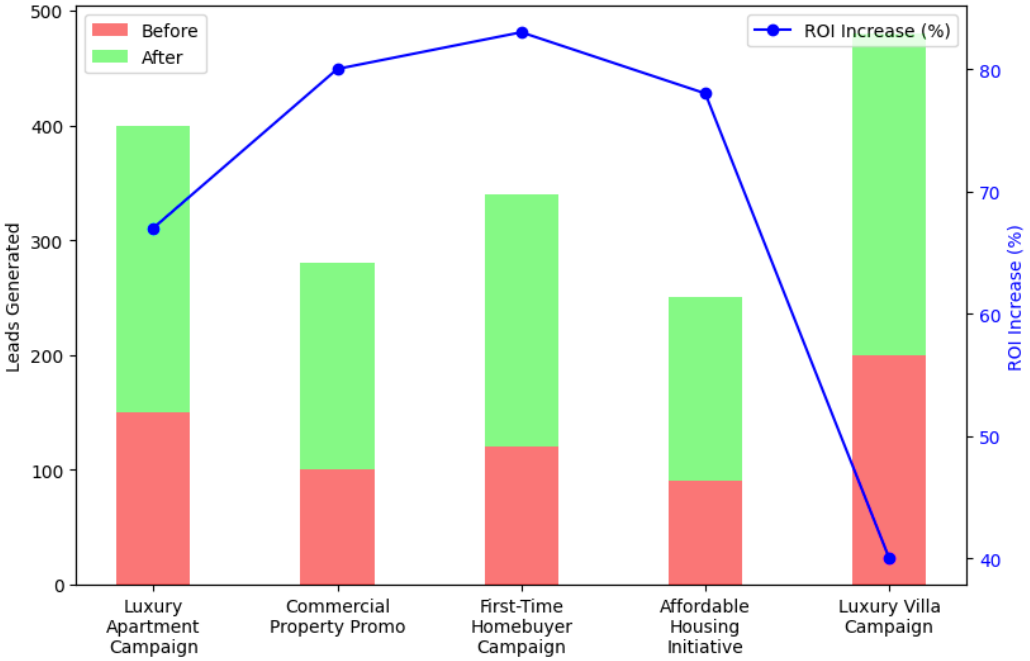

Figure 3: Marketing Campaigns with Algorithms

The optimization enhances the acquisition of customers besides increasing the effectiveness of marketing since there is sufficient distribution of resources. The findings indicate the significance of incorporating dynamic smart algorithms in real estate marketing to propel superior performance and high ROI [7][8][9].

DISCUSSION

The analysis of survey results gives unambiguous information about the current situation on the real estate marketing practice and where the application of intelligent algorithms can make a considerable difference. As Table 1 shows, the value of data-driven decision-making is accepted by real estate professionals whose mean frequency of use is 4.2, which implies that data analytics are highly used. Nevertheless, the average level of learning about intelligent algorithms, with 3.5, indicates the lack of awareness and knowledge. This area is where a deeper integration of AI and machine learning tools in marketing can be further positively applied to improve the predictive performance and targeting rates. The increasing dependency on the digital channels is supported by the large percentage of the marketing budget assigned to digital advertising (60% on average). Therefore, making algorithms efficient to capitalize on the entire power of these online platforms, by using a more individualized, effective marketing campaign, has significant potential to enhance the overall marketing power [1][2].

The comparison of algorithms performance presented in Table 2 allows identifying that Neural Networks (NN) are better than other intelligent algorithms regarding accuracy, precision, recall, and F1-score. NN has a high level of prediction accuracy (90%) and F1-score (0.88), which means that it is highly skilled in real estate marketing prediction. This is in connection with the increasing

popularity of deep learning systems in non-linear and complex data space environments. Among the findings, it can be seen that Neural Networks are able to find out the complex tendencies in customer behavior, property qualities as well as market trends; this quality allows them to be a very useful tool in lead prediction and segmentation in real estate marketing. Unlike it, although k-Nearest Neighbors (k-NN) and Support Vector Machine (SVM) show good performances, the low precision and recall of these methods indicated that maybe they are not effectively applied to large and high dimensional data like that of a real estate application. These results highlight the importance of sophisticated algorithms like NN to deal with the hindrances of real-time decision-making and predictive accuracy in dynamic markets [3][4].

The use of smart algorithms to optimize marketing campaigns is proven to have a dramatic effect on the development of leads and a return on investment (ROI). Table 3 indicated significant gains of leads following algorithm optimization in campaigns in different real estate industries with a significant lead gain being realized in First-Time Homebuyer Campaign (83%). The high ROI rises among the campaigns denotes the high targeting suitability of the optimized algorithms. Such findings prove that the optimization of the algorithm does not only enhance the generation of leads but also makes the allocation of resources and interaction with customers more effective. Predictive analytics and machine learning model can be used to implement changes in marketing strategies in real-time, aiming at reaching the right audience during the right time, and hence optimize marketing performance. This supports the fact that machine learning and AI models can greatly impact the marketing outcomes by enabling the marketers with an ability to react to real-time data and constantly optimize their approaches [5][6].

The excellent optimization of the marketing campaigns by the Neural Networks (NN) illustrated in the Table 2 and Table 3 is consistent with the results obtained by other studies in AI-oriented marketing domain. The fact that NN can deal with bulk, unstructured data like customer interactions, transaction history and property attributes makes it possible to generate leads more accurately and predict buyer behavior more accurately. The high-achievement of lead generation and ROI under different campaigns also highlights the significance of continuous model optimization which can be achieved by updating hyperparameters as well as integrating real-time data. The implications of these findings are that AI algorithms need to be refined and improved to better match the dynamics of the real estate sector, the world in which demand and trends change without warning. Finally, the incorporation of the state-of-the-art algorithms, such as NN, in the marketing strategy of the real estate may significantly increase the efficiency of marketing, acquiring more customers, and allocating resources more effectively [7][8].

CONCLUSIONS

This research highlights the significant impact of optimizing intelligent algorithms on real estate marketing performance, as evidenced by the quantitative results. The application of Neural Networks (NN) yielded an accuracy of 90% and an F1-score of 0.88, demonstrating superior predictive capabilities for lead generation and market trend forecasting. Marketing campaigns optimized with AI algorithms saw substantial improvements in lead generation, with the First-Time Homebuyer Campaign achieving an 83% increase in leads and the Commercial Property Promo recording an 80% increase. Furthermore, the ROI for all optimized campaigns showed remarkable growth, indicating more efficient resource allocation and improved targeting. These quantitative findings substantiate the effectiveness of algorithmic optimization in enhancing marketing efficiency, increasing customer acquisition, and maximizing return on investment in real estate marketing. The results affirm the critical role of advanced algorithms in transforming real estate marketing strategies and ensuring data-driven, real-time decision-making processes.

REFERENCES

1. Yuan Y. Research on real estate market prediction models based on big data and artificial intelligence. *Int J High Speed Electron Syst*. 2025;25:2540439.
2. Liu B, Li Q, Zheng Z, Huang Y, Deng S, Huang Q, et al. A review of multi-source data fusion and analysis algorithms in smart city construction: facilitating real estate management and urban optimization. *Algorithms*. 2025;18(1):30.
3. Nuseir MT, Aljumah A, Refae GAE. Revolution of the marketing mix idea using AI tech to forecast strategic marketing decision management with moderating effect of environmental parameters in UAE real estate industry. *Int J Econ Bus Res*. 2025;29(12):1–22.
4. Kandipati A. A systematic literature review on artificial intelligence-based techniques for nurturing operations in real estate sector. *J Real Estate Lit*. 2025:1–26.
5. Yang CH, Lee B, Lee YI, Chung YF, Lin YD. An autoencoder-based arithmetic optimization clustering algorithm to enhance principal component analysis to study the relations between industrial market stock indices in real estate. *Expert Syst Appl*. 2025;266:126165.
6. Odunfa VO, Fateye TB, Adewusi AO. Application of artificial intelligence (AI) approach to African real estate market analysis: opportunities and challenges. *Corros Manag*. 2025;35(1):10–18.
7. Shbool MA, Al-Dmour R, Al-Shboul BA, Albashabsheh NT, Almasarwah N. Real estate decision-making: precision in price prediction

through advanced machine learning algorithms. *Int J Hous Mark Anal*. 2025.

8. Al-Rimawi T, Nadler M. Leveraging smart city technologies for enhanced real estate development: an integrative review. *Smart Cities*. 2025;8(1):10.
9. Tarasov S, Dessoulavy-Śliwiński B. Algorithm-driven hedonic real estate pricing—an explainable AI approach. *Real Estate Manag Valuat*. 2025;33(1):22–34.
10. Vij M, Vij A, Kumar P, Masoud EY, Al Kurdi B, Alzoubi HM. Artificial intelligence in digital marketing strategies in the UAE: the mediating role of predictive analytics in enhancing customer conversion. *Int Rev Manag Mark*. 2025;15(4):380.
11. Mohammed R, Fisher R, Jaworski G, Paddison G. *Internet marketing: building advantage in an Internet economy*. New York: McGraw-Hill/Irwin; 2004.
12. Thilagavathy N, Kumar EP. Artificial intelligence on digital marketing—an overview. *NVEO Nat Volat Essent Oils J*. 2021;8(5):9895–9908.
13. Puntoni S, Reczek RW, Giesler M, Botti S. Consumers and artificial intelligence: an experiential perspective. *J Mark*. 2021;85(1):131–151. doi:10.1177/0022242920953847
14. Kishen R, Upadhyay S, Jaimon F, Suresh S, Kozlova N, Bozhuk S, et al. Prospects for artificial intelligence implementation to design personalized customer engagement strategies. *J Legal Ethical Regul Issues*. 2021;24(6):1–18.
15. Chaffey D. E-marketing and internet marketing definition [Internet]. 2010 [cited 2025 Jan 29]. Available from: Dave Chaffey website.
16. Goodell JW, Kumar S, Lim WM, Pattnaik D. Artificial intelligence and machine learning in finance: identifying foundations, themes, and research clusters from bibliometric analysis. *J Behav Exp Finance*. 2021;32:100577. doi:10.1016/j.jbef.2021.100577
17. Ruiz-Real JL, Uribe-Toril J, Torres JA, de Pablo J. Artificial intelligence in business and economics research: trends and future. *J Bus Econ Manag*. 2021;22(1):98–117. doi:10.3846/jbem.2020.13641
18. Leeflang PSH, Verhoef PC, Dahlström P, Freundt T. Challenges and solutions for marketing in a digital era. *Eur Manag J*. 2014;32(1):1–12. doi:10.1016/j.emj.2013.12.001
19. Verhoef PC, Broekhuizen T, Bart Y, Bhattacharya A, Dong JQ, Fabian N, et al. Digital transformation: a multidisciplinary reflection and research agenda. *J Bus Res*. 2021;122:889–901. doi:10.1016/j.jbusres.2019.09.022
20. Rakhmanita A, Hurriyati R, Disman D, Hendrayati H. Future research direction on branded apps: a bibliometric analysis. *J Eng Sci Technol*. 2023;18(3):33–40.
21. Bughin J, Seong J, Manyika J, Chui M, Joshi R. *Notes from the AI frontier: modeling the impact of AI on the world economy*. McKinsey Global Institute; 2018.
22. Li SS, Karahanna E. Online recommendation systems in a B2C e-commerce context: a review and future directions. *J Assoc Inf Syst*. 2015;16(2):72–107. doi:10.17705/1jais.00389
23. Gentsch P. *AI in marketing, sales and service*. Cham: Springer International Publishing; 2018.
24. Mariani MM, Perez-Vega R, Wirtz J. AI in marketing, consumer research and psychology: a systematic literature review and research agenda. *Psychol Mark*. 2022;39(4):755–776. doi:10.1002/mar.21619
25. Hussain H, Alabdullah TTY, Ahmed E, Jamal KAM. Implementing technology for competitive advantage in digital marketing. *Int J Sci Manag Res*. 2023. doi:10.37502/ijsmr.2023.6607
26. Sulaiman MZ, Aziz M, Bakar MHA, Halili NA, Azuddin M. Matterport: virtual tour as a new marketing approach in real estate business during pandemic COVID-19. In: *Proc Int Conf Innovation Media Visual Design (IMDES 2020)*. 2020. doi:10.2991/assehr.k.201202.079
27. Haleem A, Javaid M, Qadri MA, Singh RP, Suman R. Artificial intelligence (AI) applications for marketing: a literature-based study. *Int J Intell Netw*. 2022;3:119–132. doi:10.1016/j.ijin.2022.08.005
28. Frederiksen A. Competing on analytics: the new science of winning. *Total Qual Manag Bus Excell*. 2009;20(5):583. doi:10.1080/14783360902925454
29. Li H, Kannan PK. Attributing conversions in a multichannel online marketing environment: an empirical model and a field experiment. *J Mark Res*. 2014;51(1):40–56. doi:10.1509/jmr.13.0050
30. Du S, Xie C. Paradoxes of artificial intelligence in consumer markets: ethical challenges and opportunities. *J Bus Res*. 2021;129:961–974. doi:10.1016/j.jbusres.2020.08.024
31. Gupta S, Chhabria SG. The use of artificial intelligence and machine learning in digital marketing in 2023: trends and insights. *Int J Comput Appl*. 2023;184(51):12–17. doi:10.5120/ijca2023922635
32. Arun Kumar BR. AI-based digital marketing strategies—a review. In: *Inventive Computation and Information Technologies*. Vol 173. Singapore:

Springer; 2021. p. 377–387. doi:10.1007/978-981-33-4305-4_70

33. Dell'Anna F, Bravi M, Marmolejo-Duarte C, Bottero M, Chen A. EPC green premium in two different European climate zones: a comparative study between Barcelona and Turin. *Sustainability*. 2019. doi:10.3390/su11205605

34. Ullah F, Sepasgozar S, Wang C. A systematic review of smart real estate technology: drivers of and barriers to the use of digital disruptive technologies and online platforms. *Sustainability*. 2018. doi:10.3390/SU10093142

35. Nalbant KG, Aydın S. Development and transformation in digital marketing and branding with artificial intelligence and digital technologies dynamics in the metaverse universe. *J Metaverse*. 2023. doi:10.57019/jmv.1148015

36. Rafieian O, Yoganarasimhan H. Targeting and privacy in mobile advertising. *Rev Mark Sci*. 2020. doi:10.2139/ssrn.3163806

37. Volkova S, Bachrach Y, Armstrong M, Sharma V. Inferring latent user properties from texts published in social media. In: *Proc 29th AAAI Conf Artif Intell*. 2015. p. 4296–4297. doi:10.1609/aaai.v29i1.9271

38. McMahan HB, Holt G, Sculley D, Young M, Ebner D, Grady J, et al. Ad click prediction: a view from the trenches. In: *Proc 19th ACM SIGKDD Int Conf Knowl Discov Data Min*. 2013. doi:10.1145/2487575.2488200